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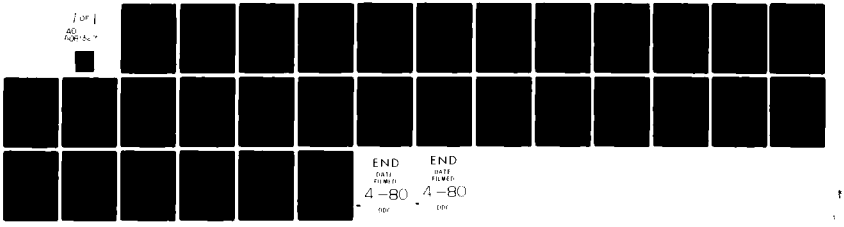

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This Working Paper describes the content and format for the ANVCE point design reports. It applies to both Air and Surface Vehicles. Once the parametric design process and state-of-the-art summaries have been completed, it is necessary to focus on a specific design (i.e., some 'point' out of the range of parametric design curves) so that meaningful evaluation can be made in three specific areas, namely Military Worth, Technical Risk Assessment and Cost. This Working Paper provides the specific listing

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TABLE OF CONTENTS

1.0 INTRODUCTION

This Working Paper describes the content and format for the ANVCE point design reports. It applies to both Air and Surface Vehicles. Once the parametric design process and state-of-the-art summaries have been completed, it is necessary to focus on a specific design (i.e., some "point" out of the range of parametric design curves) so that meaningful evaluation can be made in three specific areas, namely Military Worth, Technical Risk Assessment and Cost. The level of detail necessary in pursuing a design varies greatly with the available state-of-the-art, the need for detail and the real world constraints of cost and time. The design process follows fairly well-known phases and is basically the same whether one is concerned with either Air or Surface vehicles. Typically the design process proceeds from Conceptual Design Phase, Preliminary Design Phase and on into the Contract Design Phase. Various documents are available for describing the level of detail; one such document used here for reference is by Spaulding & Johnson.* For the purposes of the ANVCE Project it has been taken, considering all constraints, that the Point Design shall be pursued essentially to the Feasibility Design stage within the Conceptual Design Phase described in the cited Spaulding & Johnson document. This Working Paper provides the specific listing of products required for the Point Design to be pursued to the Feasibility Design Level of Detail. The design is to be documented in the format provided in this Working Paper. A separate report is to be used for each Point Design.

2.0 VEHICLE GENERAL DESCRIPTION

This section is to provide in as concise a form as possible a complete description of the vehicle. Design philosophy, trade studies, etc, are to be contained in Appendix A.

NOTE: Using ANVCE WP-002 "Definition of Terms" as a guide both English and Metric units shall be used in describing the vehicle.

2.1 PRINCIPAL CHARACTERISTICS

This section shall summarize the principal characteristics of the vehicle in numerical form. No graphs are to be presented in this section. While it is difficult to

**"Management of Ship Design at the Naval Ship Engineering Center (NAVSEC)" by K.B. Spaulding Jr. and A.F. Johnson presented at 12th Annual Technical Symposium 1975, ASE Washington, D.C.

standardize on a format that would apply to all Air and Surface vehicles, the general format of Table 1 shall be followed.

The following Table provides the format and many of the key overall characteristics needed to describe the vehicle. If the line item does not apply, leave it out; if any important descriptive characteristic is missing, put it in. This list is provided as a guide to emphasize where the overall capabilities of the vehicle are to be described. The detailed variations of the performance features along with the vehicle subsystem description are to be provided in Sections 2.2 and 2.3.

In addition to the Table which provides the principal characteristics of the vehicle, the following top level drawings shall be provided:

(a) General Arrangement Drawings (Inboard Profile and Deck Plans)

(b) Three-view drawing showing positions and identification of weapons and sensors.

These drawings are to be of sufficient detail to give overall dimensions and location of major items (e.g., location of bulkheads but not furniture).

2.2 VEHICLE PERFORMANCE

The various curves and tables which describe the vehicle's performance should be grouped in this section. For convenience and consistency among the various concepts the performance of each vehicle shall be presented in the following sub-sections.

2.2.1 THRUST, DRAG AND POWER

The thrust and drag characteristics of the vehicle shall be summarized here. The following curves shall be provided as appropriate. All data should be quoted for the full load displacement (surface vehicles) and takeoff gross weight (air vehicles)

(a) Drag/weight ratio vs speed } As a function of significant wave height

(b) Thrust/weight ratio vs speed }

(c) Propulsive efficiency vs speed

TABLE 1

PRINCIPAL CHARACTERISTICS

Operation	In ten words or less a brief description of the intended mission or operation for the vehicle
Dimensions*	
Length	
Beam (or span where appropriate).....	
Cushion Depth (or strut length)	
Cushion Area	
Cushion Pressure (or Wing Loading.... where appropriate).	
Power Plants	
Propulsion Engines	Number and Type
Propulsors	Number and Type
Lift Engines	Number and Type where applicable
Lift Fans	Number and Type where applicable
Systems	
Crew and Complement	Number and Type
Fuel	Weight and Volume Tankage
Electrical	"Ten words or less" description (include capacity of system when known)
Hydraulic	"Ten words or less" description (include capacity of system when known)
Steering	"Ten words or less" description (include capacity of system when known)
Other Auxiliary Systems	"Ten words or less" description (include capacity of system when known)
Special Systems (e.g. BLC, HAS,..)...	"Ten words or less" description (include capacity of system when known)
Weights	
Full Load Weight (Displacement)	
Empty Weight	
Fuel	
Other Loads	
Mobility Performance Summary	
Max. Speed (Calm Water)	
Max. Speed (xx metres sig. wave height)	
Hump Margin (in what wave height)....	
Best Range Speed (Calm Water)	
Best Range Speed (Sig. Wave height)..	
Climb Speed	
Rate of Climb	
T.O. Distance (Calm & Rough Water)...	
Time to accelerate to cruise speed ..	
Time to accelerate to max. speed	
Time to decelerate	
Stopping Distance	
Turning radius at speed	
Altitude limits	
Range	
Endurance	
Combat System	
Armament	Number and type (include launcher, fire control and number of reloads)
Sensors	Number and type
Command and Control	Type
Secondary Vehicles	Number and type

* This Table has been written essentially for Surface Vehicles (except for some obvious line items) and is meant to be indicative of the vehicle characteristics. Gas containment volume (for LTA); foil span and strut depth (for hydrofoil) etc. are obvious additions for other vehicles. Common sense should prevail here on the line items.

The speed range shall be from zero speed to maximum speed. The thrust/weight curves are to be provided for available ratings for the engines; e.g., maximum continuous, maximum intermittent. For consistency the thrust curves are to be presented for a standard 59° F (15° C) day and a 80° F (26.7° C) day. For air vehicles, the curves are to be presented for both sea level and some specified operating altitude as appropriate.

For those vehicles that require additional power (other than electrical and auxiliary systems power) for the vehicle concept to function, the additional presentation is required

(d) $\frac{WV}{P}$ vs speed

where $\frac{WV}{P}$ is as defined in ANVCE WP-002 and includes lift power, P_{BLC} power and ride control power.

The components of drag and power are to be included in the curves or provided in a separate plot for clarity.

For surface vehicles, the following derived curves are required

(e) Maximum sustained speed vs significant wave height. B

A discussion should be provided indicating the condition which limits the speed (e.g., added drag, motion, structural loading, etc.).

These envelopes are to be included for all modes in multi-modal vehicles (e.g., foilborne, hullborne, on-cushion, off-cushion).

For air vehicles, the following derived envelopes are to be included

(f) Maximum sustained speed vs altitude. B

For WIG craft a combination of (e) and (f) may be required to describe the performance.

2.2.2 MANEUVERING

Under this general title the overall maneuvering characteristics of the vehicle shall be presented. The curves to be supplied are:

(a) Turning radius vs speed
(b) Turning rate vs speed

} As a function of significant wave height

(c) Time to accelerate vs speed

(d) Time to decelerate vs speed

(e) Stopping distance vs speed

(f) Take-off distance*

(g) Landing distance*

(h) Rate of climb vs speed and altitude

The nature of the items (a) through (h) make it clear as to which apply to air and which to surface vehicles.

Depending on the vehicle, the above items are to be presented with appropriate limitations shown. For example, for the sea loiter vehicle, the TO/L distances and speeds are to be given as a function of significant wave height up to the limiting condition.

2.2.3 RANGE AND PAYLOAD

All ranges quoted are to be the Breguet range. The following curves are to be presented:

(a) Fuel consumption vs speed
(b) Range vs speed

} As a function of significant wave height where appropriate

(c) Endurance vs speed

(d) Payload vs range

*These should be presented for air vehicles following the conventional practice concerning 50 ft. clearance altitude and V_1 and V_2 speeds.

For consistency, the fuel consumption shall be presented as nautical miles/ton (and kilometers/metric ton) of fuel consumed.

Limitations of power ratings and weather are to be included in any such payload-range curves. Payload-range curves should assume a direct weight tradeoff between fuel and payload.

Wherever possible, conversion values to time-on station and endurance are to be given, e.g., what is the range of the VSTOL sea loiter if it makes so many TO&L on water?

2.2.4 WEIGHT AND VOLUME SUMMARY

This section shall contain the complete description of the weight and volume breakdown of the vehicle in as much detail as is available at the feasibility design state. Pending further discussion relative to any differences between air and surface vehicles, the ship work breakdown structure (SWBS) as defined in NAVSHIPS 0900-039-9010 shall be used for the presentation of all weights for the ANVCE Project.

For consistency, the weight summary shall be presented in the format shown in Table 2a and the volume summary shall be presented in the format shown in Table 2b.

For Feasibility Design, it is sufficient to provide information to the "hundred digit" level only as shown. The one exception is in the lift system (Group 567) because of the particular interest in that sub-category.

2.2.5 STABILITY

The purpose of this section is to present the overall stability characteristics of the vehicle, rather than detailed treatment of equations of motion. The items of concern relate to whether the vehicle is statically and dynamically stable in its operating modes, the vehicle's motion characteristics, especially in bad weather, and its damage stability characteristics (which apply to both surface vehicles and those air vehicles required to sit on the water).

TABLE 2a1: WEIGHT SUMMARY FOR SURFACE POINT DESIGNS C

SWBS	WEIGHT Short Tons	WEIGHT Metric Tons
GROUP 100: STRUCTURAL SYSTEM	XXX	XXX
GROUP 200: PROPULSION SYSTEM	XXX	XXX
GROUP 300: ELECTRICAL SYSTEM	XXX	XXX
GROUP 400: COMMAND AND SURVEILLANCE	XXX	XXX
GROUP 500: AUXILIARY SYSTEM*	XXX	XXX
567: Lift System	xxx	xxx
GROUP 600: OUTFIT & FURNISHINGS	XXX	XXX
GROUP 700: ARMAMENT	XXX	XXX
DESIGN AND BUILDERS MARGIN	XXX	XXX
LIGHT SHIP	XXX	XXX C
LOADS	XXX	XXX
Crews	xxx	xxx
Provisions	xxx	xxx
Stores	xxx	xxx
Fresh Water	xxx	xxx
Ordnance - Main Vehicle	xxx	xxx
- Secondary Vehicle	xxx	xxx
Secondary Vehicle (give type name)	xxx	xxx
Fuel	xxx	xxx
FULL LOAD WEIGHT	XXX	XXX

*Group 500 weight listed shall be for the entire Group 500 including lift system. The lift system (Group 567) shall be listed as indented information as shown.

TABLE 2a2: WEIGHT SUMMARY FOR AIR POINT DESIGNS C

		WEIGHT			
		Short Tons		Metric Tons	
①	Structure	XXX		XXX	
②	Propulsion Group	XXX		XXX	
③	Electrical Group	XXX		XXX	
④	Avionics (Incl. NAV and IC)	XXX		XXX	
⑤	Navigation and Interior Comm.		XXX		XXX
⑥	Auxiliary Systems	XXX		XXX	
⑦	Furnishings and Equipment Group	XXX		XXX	
⑧	Armament	XXX		XXX	
⑨	Light Vehicle(without margin)	XXX		XXX	
⑩	Margin (10% Light Vehicle)	XXX		XXX	
⑪	Light Vehicle(with Margin)	XXX		XXX	
	LOADS				
⑫	Crew and Effects		XXX		XXX
⑬	Provisions		XXX		XXX
⑭	Stores		XXX		XXX
⑮	Fresh Water		XXX		XXX
⑯	Disposable Ordnance & Sensors		XXX		XXX
⑰	Secondary Vehicle		XXX		XXX
⑱	RPV Fuel		XXX		XXX
⑲	Vehicle Fuel		XXX		XXX
⑳	Total Loads		XXX		XXX
㉑	Take Off Gross Weight	XXX		XXX	
㉒	Payload (④ - ⑤ + ⑧ + ⑯ + ⑰ + ⑱)	XXX		XXX	
㉓	Useful Load (㉒ + ⑫ + ⑬ + ⑭ + ⑮ + ⑲)	XXX		XXX	
㉔	Empty Weight (㉑ - ㉓)	XXX		XXX	

TABLE 2b: VOLUME SUMMARY

Function	Internal Volume (Cubic Meters)
Main Propulsion (including main machinery box, uptakes, shafting)	XXX
Lift System	XXX
Personnel (including living, messing and all personnel support and storage)	XXX
Auxiliary and Electrical (machinery spaces other than main propulsion and lift outside main machinery box)	XXX
Payload (internal volume only)	XXX
Other (including passageways, maintenance spaces and all other spaces not included in above)	XXX
Total Enclosed Volume	XXX

TABLE 2b1: VOLUME SUMMARY FOR AIR POINT DESIGNS C

Function	Internal Volume (Cubic Meters)
Propulsion	XXX
Auxiliary and Electrical	XXX
Personnel (including living, messing and all personnel support and stowage)	XXX
Payload (internal volume only)	XXX
Tankage	XXX
Other (including passageways, maintenance space and all other spaces not included in above)	XXX
Total Enclosed Volume	XXX

The following information shall be presented:

(a) Diagrams of damaged vehicle and plots of heeling and righting moments versus angle

(b) Variation of static margin with speed

(c) Pitch deviation with speed and significant wave height (Head Seas) B

(d) Roll deviation with speed and significant wave height (Beam Seas) B

(e) Time to half amplitude in various conditions

(f) Yaw (or sideship) limits versus speed and wave height.

2.2.6 GEOMETRIC FORM

This section shall present the "lines" of the vehicle. It shall provide sufficient information to aid in any subsequent analysis of the aerodynamic and hydrodynamic characteristics of the vehicle. The information shall include:

(a) Hull lines*

(b) Hydrodynamic parameter listing (hull L/B, cushion, length and beam, draft, cushion height/beam, foil depth, etc.)

(c) Aerodynamic parameter listing (wing aspect ratio, wing section designation (NACA xxxx), end plate air gap, height/chord ratio, tail arm, etc.)

2.2.7 RIDE QUALITY

The effectiveness of the crew and weapons system is affected to a large degree by the ride quality of the vehicle. In order to aid in the assessment the following information shall be provided:

*This drawing is to be in sufficient detail and dimensioned to provide the general shaping and (where applicable) location of waterlines.

*(a) Vertical acceleration versus frequency of encounter (for the range of wave heights considered for the operating range; Head Seas). B

*(b) Lateral acceleration versus frequency of encounter (for the range of wave heights considered for the operating range; Beam Seas). B

(c) If (a) and (b) require power expenditure to control the ride, plots of power versus frequency commensurate with the reduced acceleration shall be presented.

(d) Variation of acceleration (vertical and lateral) versus heading as a function of speed and wave height.

(e) Number of exceedances in a given time (of acceleration) as a function of acceleration level.

2.2.8 MANNING

In this section the listing and identification of ship force that the vehicle needs to conduct its military mission shall be given. Space and weight are given in other sections. Specifically, the manning shall be specified using the Navy's rate and rating structure in the format of Table 3. A brief narrative should be provided describing the function of the personnel.

2.2.9 SUPPLEMENTAL INFORMATION

The wide range of concepts being considered during ANVCE makes it difficult to devise a common format in all areas. Also, it is recognized that the different maturity level of each concept development also makes it somewhat difficult to present the unique features under common headings. The performance features listed in Sections 2.2.1 through 2.2.8 are the essential features needed to evaluate any vehicle and are therefore to be presented there as requested. If any supplemental information or

*This data (whether predicted, model scale or full scale) shall be presented both with and without any incorporated ride control system active.

TABLE 3: MANNING

VEHICLE

OFFICERS	CPO	OTHER ENLISTED
C.O.	QMC	1 QM2
X.O.	ETC	1 RM1
.	.	2 RM3
.	.	1 BM1
.	.	3 BM3
.	.	.
Weapons Officer	.	.
.	.	.
.	.	.
.	.	.
XX	XX	XX

SECONDARY VEHICLE

Helo Pilot	.	1 AT2
.	.	2 AM3
.	.	.
.	.	.
XX	XX	XX

TOTAL COMPLEMENT

XX	XX	XX

GRAND TOTAL: XXX

unique features of a particular vehicle need to be emphasized or brought to the attention of the ANVCE Project for specific consideration such information is to be grouped in this section for proper identification.

2.3 SHIP SUBSYSTEM DESCRIPTIONS

The capabilities of the vehicle in terms of its performance and overall features shall be provided in section 2.2. This major section of the Point Design Description shall be restricted to the internal subsystem descriptions. These descriptions shall comprise both concise narrative and supporting drawings.

2.3.1 STRUCTURE

The following shall be provided to describe the structure of the vehicle:

(a) A two to three page summary description of the key features of the structure identifying type of material(s), method of construction, method of production (aerospace, shipbuilding, other).

(b) A general structural arrangement drawing showing main components and type of construction. Where possible, dimensions and sizes should be given (e.g., thin-gauge aluminum requiring special skills in fabrication or thick-sheet construction allowing lesser quality control).*

(c) Sketches (not necessarily to scale) illustrating key features of the structural arrangement (e.g., how a porous composite BLC surface on a wing will be integrated with remainder of metal structure).

(d) Rough estimates of percentage weight breakdown of major elements of structure within the Group 100 weight estimate (e.g., what percentage is aluminum, what percentage is composite, etc.).

*Note that in the case of hydrofoils only a general notation of struts and foils is needed here. The corresponding structural information for these are provided in the section on Lift Systems in accordance with the SWBS.

(e) A one-page summary identifying any technical risk areas associated with obtaining the structure as proposed.

The above information is intended to provide confidence in the feasibility of the point design from a technical viewpoint, as well as to provide guidance in the establishment of the Cost Estimating Relationships (CERs) for the Cost Model.

2.3.2 PROPULSION

The following information shall be provided to describe the propulsion system of the vehicle:

(a) A one to three page summary description of the key features of the propulsion system, indicating type and number of engines, propulsors, transmission and any other related major components (e.g., waterjet inlets, propeller shrouds). The description should be complete enough so that all modes of operation of the vehicle are adequately described (e.g., hullborne versus cushion or foilborne; wide open waterjet inlets at low speed and narrow open inlets at high speeds).

(b) In tabular form provide the following information on the engines*

(1) T.I.T.
(2) Air flow
(3) Dry weight
(4) Compression ratio at max RPM
(5) SFC
(6) Maximum power at sea level
(7) Number of compressor stages
(8) Number of turbine stages
(9) Number of combustors
(10) Combustor type
(11) Length
(12) Diameter

*The list is for gas turbines. A similar list where applicable should also be provided if diesels or reciprocating engines are used, except other information such as number of pistons, etc., would be added.

(c) A general arrangement drawing showing the main components and their location within the vehicle. Where possible, dimensions, sizes, and other key information should be shown (e.g., RPM of transmission at various points from engine to propulsor).

(d) A tabulation of the characteristics of the main elements such as:

(1) Waterjet Pump (give size, power, specific speed, etc).
(2) Propeller (give diameter, number of blades, disc loading, power absorption, etc.).
(3) Nuclear reactor (give type, specific weight, temperatures, etc.).
(4) Transmission (power levels, RPM type of gear boxes, etc.).

(e) Sketches (not necessarily to scale) illustrating key features of the propulsion system (e.g., demister schemes, reactor schematic, inlet doors).

(f) Rough estimates of percentage weight breakdown of major elements of propulsion within Group 200 (e.g., what percentage is engines, transmission, propulsors).

(g) A one-page summary identifying any technical risk areas associated with obtaining the propulsion scheme.

As in the case of structure, the above information guides the establishment of confidence in the Cost Estimating Relationships (CERs) for the Cost Model.

2.3.3 ELECTRICAL SYSTEM

The following shall be provided to describe the electrical system of the vehicle:

(a) A one to two page summary description of the key features of the electrical system, identifying type of system (e.g., gas turbine driven generator) and type of components (shipboard wiring or aircraft aluminum wiring, etc.).

(b) A general schematic showing main components and mode of operation.

(c) A general arrangement drawing showing location of componenets in the vehicle.

(d) A tabulation of key information such as frequency, power levels and redundancy factors.

(e) Rough estimates of percentage weight breakdown of major components with Group 300 (e.g., what percentage is wiring, what percentage is generator set, etc.).

(f) A one-page summary identifying any risk areas associated with the electrical system as proposed, (e.g., are components available today or are special lightweight generators required to be developed).

2.3.4 COMMAND, CONTROL AND COMMUNICATION (C^3)

(a) A list of equipment for command, control, communications functions.

(b) A table listing weight and volume for C^3 subsystems, and weight for IC and navigation functions.

(c) A general arrangement drawing showing the location of the C^3 system major components within the vehicle.

(d) A one-page summary identifying any risk areas associated with the C^3 system.

(e) An identification either by drawing, tabulation or statement as to how much of the systems related to the vehicle functions as a platform and how much is related to the military operation functions. (Information to be provided by component identification and percentage weight and volume.)

2.3.5 AUXILIARY SYSTEM

The presentation of information in this section is to be presented in two parts, viz:

2.3.5.1 Auxiliary System Less Lift System
2.3.5.2 Lift System

In this manner, proper accounting can be kept pertaining to weight, cost and risk assessment.

2.3.5.1 AUXILIARY SYSTEM LESS LIFT SYSTEM

The following information shall be provided to describe the HVAC, hydraulic, pneumatic, steering, etc., systems onboard the vehicle:

(a) General arrangement drawings of each of the main auxiliary systems showing location of major components.

(b) An identification by tabular format of the basic characteristics of the major components (e.g., 3000 psi hydraulic pumps and motors, 10 gallon reservoirs; etc.).

(c) A rough estimate of the percentage weight of each major auxiliary system comprising the total weight of Group 500 (less Group 567).

(d) A one-page summary identifying any risk areas associated with the above referenced auxiliary system.

2.3.5.2 LIFT SYSTEM

The lift systems as defined in Group 567 include the engines, fans and skirt systems for ACV and SES; the strut and foil systems for hydrofoils and for the purposes of ANVCE shall include any BLC systems for the air vehicles. It shall also include any ride control systems incorporated into the vehicle.

For those vehicles that make use of integrated systems (e.g., an ACV or SES takes power off the propulsion engine in Group 200 to drive the lift system here in Group 567 or an air vehicle that bleeds power from the propulsion engine to drive a BLC pump to improve the lift system) a slightly different treatment is required. For the purposes of ANVCE,the presentation of information shll be separated into either Group 200 or Group 567 according to where the actual system is also separated. For example, if in the case of an ACV the drive system for lift system is taken from the propulsion engine than the engine (and its

description) shall be presented in Group 200 and the drive, fan and skirt system shall be presented in Group 567. It is believed that this rule will fit all proposed systems and will provide a logical identification.* Accordingly, the following information shall be provided:

(a) A one to two page summary description of key features of the lift system and its method of operation (passive skirts, anti-bounce bags, incidence control, blowing or sucking BLC, etc.).

(b) A general arrangement drawing showing the complete lift system (with the interface shown for integrated systems).

(c) Line drawings of major components such as skirt geometry, skirt and foil sizes in sufficient detail to identify main dimensions (finger height, bag radius, foil span, skirt length, etc.).

(d) Tabulation of key parameters for the lift system (e.g., fan diameter, RPM, skirt material weights, engine characteristics (if not already given in Group 200), foil aspect ratio and span, skirt and foil material, etc.).

(e) A rough estimate of the percentage weight of each major component of the lift system within Group 567.

(f) A one-page summary identifying any risk areas associated with the above referenced lift systems.

2.3.6 OUTFIT AND FURNISHINGS

The following information shall be provided:

(a) A one to two page summary describing the key features of the O&F system.

(b) A general arrangement drawing (by deck if necessary) to show the location of all manned areas in the vehicle.

(c) A rough estimate of the percentage weight of each major component of the O&F system.

*For WIG vehicles, if the end plate is passive it is to be included in Group 100, if it is active it is to be included in Group 567.

(d) A one-page summary identifying any risk areas associated with the above referenced O&F system.

2.3.7 COMBAT SYSTEM

The following information shall be provided:

(a) A one to three page summary describing the key features of the combat system (weapons, fire control, sensors, etc.).

(b) If necessary, a drawing such as an inboard profile to further amplify the location of the weapons and sensors as shown on three-view drawing provided in Section 2.1(b).

(c) A tabulation of the weight and volume characteristics of all weapons and sensors carried. (Data to be extracted from the ANVCE, Combat System Data Sheets (Vols 1 and 2) of 30 June 1976).

(d) A statement of weight compatible with those of Table 2 but identifying,

(1) Combat System Weight
(2) Military Payload

The intent here is to clearly identify that weight which is "removable" from the vehicle and that which is "integrated" with the other vehicle systems. ANVCE Working Paper WP-002, "Definitions of Terms" provides the necessary definition of the pertinent items.

(e) A one to two page summary identifying any risk areas associated with the Combat System, paying particular attention to any limitations incurred by the characteristics of the vehicle (e.g., vehicle angular motion, accelerations and vibrations).

2.4 SURIVIVABILITY AND VULNERABILITY

The question of the survivability and vulnerability of advanced naval vehicles is an important one and two key areas need to be addressed. These areas are (a) Signature and (b) Hardness. Accordingly, the following

information is to be provided for evaluation. It is recognized that at the feasibility design state of any vehicle the amount of detail that can be provided in such areas is not over-abundant, in which case the information is to be in the category of "best available."

2.4.1 SIGNATURE CHARACTERISTICS

Signatures shall be provided for the estimated "worse case" aspect angle. The estimated "worse case" aspect angle shall be specified.

(a) Radar Cross-Section (.3-18 GHz)

In addition, list any potential techniques for cross-section reduction.

(b) Microwave Signature

(c) Infrared Signature

In addition, list any potential techniques for signature reduction (e.g., glint, aerodynamic, exhaust).

(d) Visibility

Probability for unaided visual detection at 5 nm in 15+ nm visibility conditions. In addition, list any potential techniques for signature reduction.

(e) Acoustic Signature

The acoustic information needed pertains to both airborne and waterborne generated noise. For those vehicles that are likely to generate both forms of noise, information is required in both areas. For airbone noise the reference level shall be the cruise speed threshold range (in meters) for 45 db sound pressure level in 250 Hz octave band. For waterborne noise the target strength for active detection in db intensity shall be referenced to the incident signal at 1 yd from the acoustic center.

The noise signature is to be provided as follows:

	10kts	50kts	80kts	120kts
Intensity of highest line (0-100Hz)..	xx	xx	xx	xx
Intensity of highest line (>100Hz)..	xx	xx	xx	xx
Intensity of 1/3 octave band (2kHz)..	xx	xx	xx	xx

Does this vehicle have a distinctive line spectra?
Is the acoustic signature highly directional?
What is the potential for signature reduction?

2.4.2 HARDNESS

The following information shall be provided to describe the protective features incorporated into the craft:

(a) A description of the survivability/vulnerability considerations made to bear with the arrangements of components/equipment. This has to do with redundancy, separation, and minimization of exposure. Schematic drawings shall be provided as necessary.

(b) A description of the armor provided against conventional weapons, together with a drawing showing armor locations and components protected.

(c) A statement of the level of shock hardness (keel shock factors for underwater explosions) adopted for equipment. The hardness shall be given for both hull-borne and foil- or bubble-borne conditions of the craft. A listing of shock-hardened equipment shall be provided. Also provided shall be a listing of equipment for which risks or difficulties are expected in obtaining shock hardness, together with a summary assessment of these.

(d) A description of the protection provided against blast/heat from onboard guns and missiles.

(e) A description of the systems adopted for control of fire and flooding, together with an assessment of their effectiveness after weapons inflicted damage to the vessel. Schematic drawings shall be provided as appropriate.

(f) A description of the passive fire protection features adopted and the reasons for their selection. Schematic drawings shall be provided as appropriate.

(g) Curves showing kill probabilities (probability of inactivation given hit) for the following threats:

- o anti-ship missile
- o medium to large projectile
- o 30 Cal projectile
- o torpedo
- o mine

3.0 LOGISTIC CONSIDERATIONS

Due to the novel characteristics of many of the advanced naval vehicles it is important to identify any peculiar logistics related requirements and to identify whether they incur a reduction or an increase in current logistics support activities within the U.S. Navy. This logistics information is required for the cost model and for the understanding of the operational concept. The information should be expressed in concise statements (with any clarifying sketches). If at all possible, this section should be limited to not more than five pages of text.

In addition, information is rquired concerning the reliability and availability of the vehicle. This information is required for both the military worth and cost models. While the accuracy of such information is difficult to assess at the Feasibility Study level, as much use as possible should be made of data from similar programs to obtain estimates of pertinent parameters. These estimates are essential to provide guidance for cost analysis and input to other related areas including the impact of availability, maintenance concepts, and support requirements on force planning.

3.1 RELIABILITY AND AVAILABILITY

(a) Provide estimates of reliability and availability consistent with the planned utilization and the maintenance and support concepts of the vehicle.

(b) Provide a ship system availability block diagram and an availability block diagram for each of the major subsystems.

(c) For the major component blocks in the subsystem block diagrams, provide estimates for the MTBF (Mean-Time-Between-Failure) and the MTTR (Mean-Time-To-Repair

3.2 MAINTENANCE CONCEPT

Describe the resources necessary to implement the prescribed maintenance concepts. Ensure that significant requirements for all areas of ILS (less overhaul and supply support which are treated below) are identified so that

these resources can be included in the total force structure associated with the vehicle and incorporated in life cycle costing. Specifically identify support features which are not standard Navy methodologies or are estimated to be in excess of those provided to a conventional vehicle. Resources addressed should include but are not limited to:

(a) Shipyard facility requirements.

(b) Depot level maintenance requirements.

(c) Tenders/repair ships/floating drydocks/host ships or other afloat intermediate maintenance facilities.

(d) Shorebased intermediate maintenance facilities.

(e) Special organizational level maintenance requirements.

(f) For the above major impact on support facilities and other support features should be identified and described. These include such things as:

- o Land-based test facilities
- o Unusual drydock or pierside configurations
- o Unusual manning, training, or personnel movement approaches
- o New or unique support technologies
- o New or unique packaging, handling, storage, and transportation features
- o Equipment (rotatable) pools
- o Designated equipment repair facilities
- o Modularity

3.3 OVERHAUL CONCEPT

Describe the overhaul approach including scheduling, facilities, pipeline requirements for modular replacement, and the like. Ensure that requirements affecting life cycle costing are identified and fully described. Specifically identify features which are new or unique. Items addressed should include:

(a) Scheduling

(b) Pipeline requirements

(c) Shipyard or other overhaul facility requirements including unusual drydock or pierside configurations

(d) Land-based test or other facilities

(e) Interfaces with the maintenance program described above.

3.4 SUPPLY SUPPORT CONCEPT

Describe the resources necessary to implement the prescribed supply support concept. Ensure that significant supply support requirements, such as new or unique service force capabilities, are identified. Supply support features which will impact life cycle costing must be fully described. Items to be addressed include:

(a) Additions or modifications to Mobile Logistic Support Force ships (e.g., new design tenders, repair, or host ships).

(b) Unique shore facilities, e.g., land-based test sites, specialized port facilities, or advanced bases.

(c) Unique replenishment techniques.

(d) Unique supply support procedures.

4.0 TECHNICAL RISK ASSESSMENT

A one page summary shall be provided in concise statement(s) form of each of the risk areas, provided in more detail in the Section 2.3 descriptions.

APPENDIX A

DESIGN PROCESS

It is to be recognized that the Point Designs will be arrived at from different technology bases and design data bases. It is also expected that different standards, criteria and assumptions will be used because of the different program offices and other Navy organizations involved e.g., structural safety factors between different vehicles are not the same, weight margins are frequently different and different ambient conditions are assumed in quoting engine performance.

The ANVCE Project is gradually evolving a set of consistency information that is to be used where practical "across the board". Two such documents that contain such information are ANVCE WP-002 "Definitions of Terms" and this document. A format for presentation of the specific information on the Point Design is contained within the body of this document. As a further aid to making proper evaluation of a Point Design some insight is needed into the design approach, criteria, philosophy and trade studies need in arriving at such a design. This Appendix is to collect in summary form those pieces of information needed to identify the source of data and design process used.

A.1 APPROACH

For a basic vehicle configuration and the major subsystems, several methods of establishing characteristics exist. They may be classified into three groups, viz:

(a) Scaling - projection of characteristics based on rationing up or down from a chosen vehicle.

(b) Modification - developing of characteristics based on small changes to an existing vehicle.

(c) Synthesis - development of characteristics based on design data, parametric analysis and theoretical investigations.

The approach used for the particular Point Design presented shall be identified and presented in concise form.

A.2 DESIGN CRITERIA

Those pertinent design criteria, standards and assumptions used in the Point Design shall be provided in the following areas. Use tabular forms or references as appropriate.

(a) Hull Structure
e.g., design stresses, material properties, minimum guage.

(b) Propulsion
e.g., transmission losses, thrust margin, salt injestion, ducting losses.

(c) Electrical Plant
e.g., growth margin, power factor, redundancy.

(d) Command and Surveillance
e.g., sensor interface, space requirements.

(e) Auxiliary Systems
e.g., material properties

(f) Lift System
e.g., transmission losses, material properities, skirt wear, design stress.

(g) Outfit and Furnishings
e.g., fire loading, space growth, hot or cold bunks, habitability standards,

(h) Armament
e.g., arcs of fire limits, magazine special requirements

(i) Loads
e.g., crew weight allowances, stores weight allowances, helo fueling requirements.

(j) Weight Margins
e.g., design, builders, contract design, GFM, future growth, service life.

(k) Vehicle
e.g., safety requirements, damage stability.

(l) Manning
e.g., conditions of readiness, human factors.

(m) Performance
e.g., hump margin, T.O/L margin.

A.3 DESIGN PHILOSOPHY

Present a concise description of the design philosophy used in designing the vehicle. The design philosophy shall describe the guidance used by the designer in maing trade-off designs e.g., minimize cost, maximized performance.

A.4 TRADE-OFF STUDIES

Present a concise description of the main trade-off studies which were performed under the following headings:

(a) Configuration - examples might be partial length vs full length sidehull (SES), single strut vs twin strut (SWATH) and candard vs airplane (hydrofoil).

(b) Subsystem - examples might be diesel vs gas turbine, propeller vs waterjet, 400 Hz vs 60 Hz.

(c) Performance - examples might be optimizing for cruise speed with a dash speed capability vs optimize for maximum speed.

While no page limit is given for this Appendix, it is emphasized that what is sought is a concise description of the major elements rather than a design manual.